

REMARKS

Applicants appreciate the Examiner's thorough examination of the present application as evidenced by the Office Action of March 26, 2007 (hereinafter "Office Action"). In response, Applicants have amended independent Claims 1 and 25 to clarify the description of the disposition of the capacitor to eliminate any possibility of confusion. Applicants respectfully submit that the cited references fail to disclose or suggest all of the recitations of the pending independent claims, as amended. Accordingly, Applicants submit that all pending claims are in condition for allowance. Favorable reconsideration of all pending claims is respectfully requested for at least the reasons discussed hereafter.

Interview Summary

Applicants wish to thank the Examiner for discussing the final Office Action mailed February 28, 2007 ("Final Action") and the decision to withdraw the Final Action in light of Applicants' request for a suspension of action that accompanied the Request for Continued Examination filed April 26, 2006. Applicants respectfully request that the present remarks constitute an Interview Summary pursuant to MPEP §713.04 for the interview held March 13, 2007.

Section 112 Rejections

Independent Claim 1 stands rejected under 35 U.S.C. §112, second paragraph, as being indefinite because of the reference to the capacitor being disposed on an upper surface of the TiN plug opposite the substrate. (Office Action, page 2). Similarly, independent Claim 25 stands rejected under 35 U.S.C. §112, second paragraph, as being indefinite because of the reference to the capacitor being disposed on an upper surface of the TiN plug opposite the lower conductive layer. These recitations were included to better identify the upper surface of the TiN plug. Because the Office Action states that these clarifications are confusing rather than clarifying the relationship between the upper surface of the TiN plug and other recited elements, Applicants have amended Claims 1 and 25 to eliminate the recitations "opposite the substrate" and "opposite the lower conductive layer," respectively.

Independent Claims 1 and 25 are Patentable

Independent Claims 1 and 25 stand rejected under 35 U.S.C. §103(a) as being unpatentable over by U. S. Patent No. 5,672,543 to Chang *et al.* (hereinafter "Chang") in view of U. S. Patent No. 6,404,058 to Taguwa (hereinafter "Taguwa") and further in view of U. S. Patent No. 6,534,809 to Moise (hereinafter "Moise"). (Office Action, page 3).

Independent Claim 1 is directed to an integrated circuit device and recites, in part:

- a substrate;
- an insulating layer disposed on the substrate having a gap formed therein;
- a TiN liner layer that exhibits compressive stress characteristics disposed on sidewalls of the insulating layer, which define the gap, and on the substrate in the gap;
- a TiN contact plug that exhibits tensile stress characteristics disposed directly on the TiN liner layer; and
- a capacitor disposed on an upper surface of the TiN contact plug and comprising a lower electrode that contacts an upper surface of the TiN contact plug and an upper surface of the TiN liner layer.

Similarly, Claim 25 is directed to a contact plug of a semiconductor device and recites, in part:

- a TiN plug having an upper surface contacting the upper conductive layer and having tensile stress;
- a TiN liner contacting the TiN plug so as to surround the TiN plug along the side wall and the bottom of the TiN plug and having compressive stress; and
- an ohmic layer contacting the TiN liner on the opposite side of the TiN plug and located between the TiN liner and the insulating film and between the TiN liner and the lower conductive layer;
- wherein the capacitor is disposed on an upper surface of the TiN plug and comprises a lower electrode that contacts an upper surface of the TiN contact plug and an upper surface of the TiN liner.

Thus, both Claims 1 and 25 recite that a capacitor is disposed on the TiN plug and contacts both an upper surface of the contact plug and an upper surface of the TiN liner. FIG. 2 of the Specification of the present application illustrates exemplary embodiments of the present invention in which a capacitor is disposed on the upper surface of the TiN plug.

Turning first to Chang, as acknowledged in the Office Action on page 3, Chang does not disclose or suggest the use of a TiN plug, but instead describes the contact plug as being a tungsten plug (Chang, FIG. 8, tungsten plug 28). Moreover, Chang does not include any disclosure or suggestion with respect to the formation of a capacitor on an upper surface of a contact plug. Taguwa, however, does disclose a capacitor in combination with a contact plug in FIGS. 5A -5D. The architecture of the device shown in FIGS. 5A - 5D of Taguwa does not

correspond to the recited elements of independent Claims 1 and 25. For example, Claim 1 recites a TiN liner layer disposed on sidewalls of the insulating layer in a gap and a TiN contact plug. Taguwa shows two TiN elements in FIGS. 5A - 5D: a TiN film 48 and a TiN film 50. TiN film 48 is not formed in the gaps in the silicon dioxide film 47 so it cannot be the TiN liner layer recited in Claim 1. This leaves TiN film 50 being the only option for corresponding to the TiN liner layer of Claim 1. If this is the case, then Taguwa does not show a lower electrode of a capacitor that contacts an upper surface of a TiN contact plug (TiN film 48) and an upper surface of the TiN liner layer (TiN film 50). Taguwa shows tantalum oxide film 51 contacting an upper surface of the TiN film 50, but does not contact an upper surface of the TiN film 48. The same analysis applies likewise to independent Claim 25.

The Moise reference fails to provide the teachings missing from Chang and Taguwa. As shown in FIG. 1 and described at col. 9, lines 27 - 30, Moise discloses a capacitor 125 that may be formed on a plug 114 or a barrier layer 122. Moise does not include any disclosure or suggestion of forming a capacitor that has a lower electrode that contacts both an upper surface of a TiN contact plug and an upper surface of a TiN liner.

As discussed above, even if combined, the Chang, Taguwa, and Moise references fail to disclose or suggest all of the recitations of independent Claims 1 and 25. Applicants further submit that there would be no motivation for combining the teachings from these three different references. Chang, for example, is directed to methods of tungsten plug metallization (Chang, col. 1, lines 1 - 13), while Taguwa and Moise are not directed to the use of tungsten in forming contact plugs. As discussed in the Specification on page 2, lines 16 - 28, one skilled in the art would not be motivated to merely replace a tungsten plug with a TiN plug due to concerns with cracking. Moreover, Taguwa describes the formation of a contact plug and lower electrode of a capacitor as a unitary component (Taguwa, col. 9, line 62 - col. 10, line 2), while Moise describes forming the contact plug and lower electrode of a capacitor as separate elements (lower electrode 124 and contact plug 112 shown in FIG. 1 of Moise). Thus, the teachings of Taguwa and Moise are incompatible with respect to the formation of a contact plug and a lower electrode of a capacitor. It appears, therefore, that the Office Action gains its alleged impetus or suggestion to combine the cited references by hindsight reasoning informed by Appellants' disclosure, which is an inappropriate basis for combining references.

Accordingly, for at least the foregoing reasons, Applicants respectfully submit that

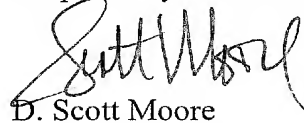
In re: Sang-bom Kang et al.
Serial No.: 10/050,195
Filed: January 16, 2002
Page 8 of 8

independent Claims 1 and 25 are patentable over the cited references and that Claims 3 - 7, 13, 14, and 26 - 31 are patentable at least per the patentability of independent Claims 1 and 25.

CONCLUSION

In light of the above amendments and remarks, Applicants respectfully submit that the above-entitled application is now in condition for allowance. Favorable reconsideration of this application, as amended, is respectfully requested. If, in the opinion of the Examiner, a telephonic conference would expedite the examination of this matter, the Examiner is invited to call the undersigned attorney at (919) 854-1400.

Respectfully submitted,



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